

REMARKS/ARGUMENTS

Status of Claims

Claims 13, 15-18, 23-28, 31, 32, 34-38, and 40-44 are being resubmitted. Claims 13, 28, 32, 36, 38, 41, and 43 have been amended. Claims 1-12 have been canceled as being drawn to a non-elected invention. Claims 14, 19-22, 29, 30, 33, and 39 have been canceled without prejudice or disclaimer of the subject matter. No new claims have been added.

The Examiner rejected Claims 13, 15-19, 23-27, 32, and 43 under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement.

Claims 13, 15, 16, 19, 23, 24-28, 31, and 35 were rejected by the examiner under 35 U.S.C. 103(a) as being unpatentable over Brenner et al. (U.S. Patent No. 2,643,221) in view of Beebe, Jr. et al. (U.S. Patent No. 3,350,773) and Sturgill et al. (U.S. Patent Application No. 2003/0234063).

The Office Action further rejected Claims 17, 18, and 34 under 35 U.S.C. 103(a) as being unpatentable over Brenner et al. (U.S. Patent No. 2,643,221) in view of Sturgill et al. (U.S. Patent Application No. 2003/0234063), Beebe, Jr. et al. (U.S. Patent No. 3,350,773), and further in view of Kedward et al. (U.S. Patent No. 4,305,792).

The Office Action still further rejected Claim 32 under 35 U.S.C. 103(a) as being unpatentable over Brenner et al. (U.S. Patent No. 2,643,221) in view of Beebe, Jr. et al. (U.S. Patent No. 3,350,773) and Sturgill et al. (U.S. Patent Application No. 2003/0234063), and in further view of Du Rose (U.S. Patent No. 3,355,267).

The Office Action still further rejected Claim 33 under 35 U.S.C. 103(a) as being unpatentable over Brenner et al. (U.S. Patent No. 2,643,221) in view of Beebe, Jr. et al. (U.S. Patent No. 3,350,773) and Sturgill et al. (U.S. Patent Application No. 2003/0234063) and further in view of Lichtenberger et al. (U.S. Patent No. 4,786,390).

The Office Action still further rejected Claim 36 under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under U.S.C. 103(a) as being unpatentable over Brenner et al. (U.S. Patent No. 2,643,221).

The Office Action still further rejected Claims 37 and 40 under 35 U.S.C. 103(a) as being unpatentable over Brenner et al. (U.S. Patent No. 2,643,221) in view of Sturgill et al. (U.S. Patent Application No. 2003/0234063).

The Office Action still further rejected Claim 38 under 35 U.S.C. 103(a) as being unpatentable over Brenner et al. (U.S. Patent No. 2,643,221) in view of Sturgill et al. (U.S. Patent Application No. 2003/0234063), and further in view of Brar et al. (U.S. Patent No. 5,240,590).

The Office Action still further rejected Claims 41, 42, and 44 under 35 U.S.C. 103(a) as being unpatentable over Brenner et al. (U.S. Patent No. 2,643,221) in view of Beebe, Jr. et al. (U.S. Patent No. 3,350,773), Sturgill et al. (U.S. Patent Application No. 2003/0234063), and Brar et al. (U.S. Patent No. 5,240,590).

Claim 43 was rejected under 35 U.S.C. 103(a) as being unpatentable over Brenner et al. (U.S. Patent No. 2,643,221) in view of Beebe, Jr. et al. (U.S. Patent No. 3,350,773), Sturgill et al. (U.S. Patent Application No. 2003/0234063), and Brar et al. (U.S. Patent No. 5,240,590), and further in view

of Du Rose (U.S. Patent No. 3,355,267).

The amended Claims are supported, for example, by paragraphs [024], [027], and [030]. No new matter has been added. Paragraph [024], for example, states that the obtained coating is a "wear resistant coating 13" (Figure 2) and that the coating "meets the engineering requirements of aircraft wear coatings", while paragraph [019] states that the coating "meets or exceeds the engineering properties of prior art chromium plate. Therefore, the wear resistant coating as in independent Claims 13, 28, 36, and 41 (as amended) has a minimum thickness of 0.002 inches or 51 μm , as defined in the Aerospace Material Specification AMS-QQ-C-320 for Chromium Plating (Electrodeposited). The wear resistant coating as in independent Claims 13, 28, 36, and 41 (as amended) is a class 2 - engineering plating according to AMS-QQ-C-320 with the requirements specified under 3.4.2.

Examiner Interview

A telephone interview was conducted between the Examiner and Applicant's representative. Proposed amendments to the claims were discussed. Further discussed were the cited references Brenner '221, Beebe, Jr. et al. '773, and Sturgill et al. '063. No agreement was reached.

Section 112 Rejections

Independent Claim 13 was amended to include the limitation "sodium chloride" supported by the specification, for example, in paragraph [027] to replace the limitation "alkali chloride" rejected by the examiner as not to comply with the written description requirement.

Claims 32 and 43 were amended to limit the temperature range to "110

to 160°F", which is supported by the specification, for example, in paragraph [027] to replace the limitation of "100°F" rejected by the examiner as not to comply with the written description requirement.

Brenner et al. (U.S. Patent No. 2,643,221)

Brenner et al. teach plating solutions for electro-deposition of phosphorous-cobalt alloys (Fig. 9, bath 4 and 5), which contain cobalt chloride, cobalt as phosphate or phosphite, phosphite (H_3PO_3), and phosphate (H_3PO_4). In order to control the pH value within narrow limits, buffers, such as boric or phosphoric acid, are added to the plating solution (Col. 3, lines 24-25). Brenner et al. found that the pH value of high phosphite baths, such as bath 5 in Figure 9, "must be kept between 0.5 and 1.0" (Col. 4, lines 65-68). Furthermore, Brenner et al. teach electrodepositing of cobalt-phosphorous alloys, see, for example, Col. 1, lines 10-12, Col. 2, lines 20, Col. 5, lines 32-34, but do fail to teach electro-depositing of cobalt-phosphorous-boron alloys. The Examiner's assumption that boric acid used by Brenner et al. would inherently comprise boron in the coating cannot be found true. Brenner et al. use boric acid in the plating bath as a buffer (Col. 3, lines 24-25) that does not get co-deposited. The fact that boric acid is not co-deposited is utilized, for example, in the electronics industry, where high purity deposits are required. Still further, Brenner et al. do not include boron as perborate or sodium chloride in the plating bath.

Contrary to Brenner et al., the present invention teaches a plating bath that enables obtaining a cobalt-phosphorous-boron coating through electroplating (as in independent Claims 13 and 28, as amended). The plating solution as in Claims 13 and 28, as amended, includes cobalt metal ions as cobalt sulfate, chloride ions as sodium chloride, boron as perborate, phosphite as phosphorous acid, and phosphate as phosphoric acid, while the plating

solution of Brenner et al. does not include perborate or sodium chloride. The addition of perborate enables to maintain a stable pH value in the range from about 1 to 1.8 without other additions other than the phosphorous acid (phosphite) as well as improving the bright deposition range by producing fine-grained deposits over a wide range of process variables such as current density and temperature (as in Claims 13 and 28 (as amended), and as supported in paragraph [027]). The range of 1.6 to 2.6 oz/gal of phosphorous acid provides a high concentration of phosphorous ions in the plating solution (Claims 13, 28, 36, and 41, as amended). Brenner states in Col 4, lines 65-68 that the pH of "high phosphite bath...must be kept between 0,5 and 1.0", which is below the pH range of 1 to 1.8 as in Claims 13 and 28 as amended of the present invention. Adding sodium chloride to the plating bath (as in Claims 13, 28, 36, and 41, as amended) enables to obtain a relatively thick coating with low residual stress, a fact that was not known in the art or expected at the time of the present invention. Since residual stress in the coating affects the fatigue properties of the base metal (as in paragraph [0027]), the usage of sodium chloride is essential to obtain the wear resistant cobalt-phosphorous-boron coating having a thickness of at least about 0.002 inch of the present invention (as in Claims 13, 28, 36, and 41, as amended).

Furthermore, Brenner et al. teach plating at 75°C (167°F) or at room temperature (Col. 5, line 4 and lines 7-8), while the present invention as in Claims 32 and 43 (as amended) teaches a plating bath having a temperature in the range from 110°F to 160 °F, which does not include the temperatures taught by Brenner et al.

Still further, the phosphorous acid contend listed by Brenner et al. in Figure 9 is with 2 g/l and 40 g/l outside of the range of 1.6 to 2.6 oz/gal (12 to 19.5 g/l) of the present invention, as in Claims 13, 28, 36, and 41, as amended.

Therefore, Brenner et al. do not anticipate or make obvious the present invention as in Claims 13, 15-18, 23-28, 31-38, and 40-44 (as amended) either alone or with the other references of record. Consequently, the section 102 (b) and section 103 (a) rejections should be withdrawn.

Beebe, Jr. et al. (U.S. Patent No. 3,350,773)

Beebe, Jr. et al. teach a method for making bearings. The method taught by Beebe, Jr. et al. includes a plating step, wherein a plating of cobalt-phosphorous is applied to a surface (Col. 4, lines 2-5). Electrolytic deposited cobalt can be achieved with well-known techniques employing an aqueous acid solution containing, for example, cobalt sulfate, sodium chloride, and boric acid. The plating solution has a pH value of about 5.2 and a temperature of about 75 °F. A current density of about 40 amperes per square foot is required for depositing cobalt plating (Col. 4, lines 17-34). Another plating solution is used by Beebe, Jr. et al. for plating of cobalt-phosphorous and includes cobalt chloride, sodium hypophosphite, ammonium chloride, and sodium citrate, the solution having a pH Value of about 8 to 9 and a temperature of about 195 °F (Col. 4, lines 35-44). The cobalt or cobalt-phosphorous coating form a barrier interlayer for achieving bonds between a steel backing strip and a aluminum strip (Col. 2, lines 21-32; Col. 4, lines 8-10).

Both, the cobalt plating and the cobalt-phosphorous plating have a thickness of about 0.000025 inches to about 0.0005 inches, as stated in Col. 4, lines 2-5.

Contrary to Beebe, Jr. et al., the present invention as in Claims 13 and 28, (as amended) and as in their dependent Claims (as amended) teaches a plating solution that includes cobalt sulfate, sodium chloride, perborate, phosphite (phosphorous acid) and phosphate (phosphoric acid). This solution

can be compared with the cobalt-phosphorous plating solution of Beebe, Jr. et al., described in Col 4, lines 35-44. The plating solution of the present invention has a pH value of about 1 to 1.8, while the cobalt-phosphorous plating solution of Beebe, Jr. et al. has a pH value in the range of about 8 to 9 (Col. 4, lines 40-41). Contrary to the solution of the present invention (as in Claims 13 and 28, as amended), the cobalt-phosphorous plating solution of Beebe, Jr. et al. does contain cobalt as cobalt chloride instead of cobalt sulfate and does not contain sodium chloride or perborate. Since the cobalt-phosphorous plating solution of Beebe, Jr. et al. does not contain boron as perborate, no cobalt-phosphorous-boron coating as in the present invention (as in Claims 13 and 28, as amended) can be obtained. The cobalt-electroplating bath of Beebe, Jr. et al. (Col 4, lines 24-34) includes cobalt sulfate, boric acid and sodium chloride as does the present invention (as in Claims 13 and 28, as amended) but fails to contain perborate, phosphite, and phosphate. As is well known in the art, boric acid is a buffer that inhibits hydrogen evolution that causes a rise in the pH of the plating solution and does not get co-deposited. Therefore, by using boric acid no boron will be included in the coating obtained by Beebe, Jr. et al., while by using perborate in the present invention (as in Claims 13 and 28, as amended) boron is deposited in the obtained coating.

Furthermore, the present invention teaches a wear resistant coating that meets the engineering requirements of aircraft wear coatings, such as chromium plate, that are defined in the Aerospace Material Specification AMS-QQ-C-320 for Chromium Plating (Electrodeposited). The minimum thickness of the coating of the present invention is 0.002 inches (51 μm) (as in Claims 13 and 28, as amended) while the maximum thickness of the coating of Beebe, Jr. et al. is 0.0005 inches (Col. 4, lined 14-16). Therefore, the cobalt-phosphorous-boron coating of the present invention (as in Claims 13 and 28, as amended) is at least 4 times thicker than the coating of Beebe, Jr. et al.

Still further, Beebe, Jr. et al. teach plating temperatures of 75°F (cobalt bath) and 195°F (cobalt-phosphorous bath) which do not lie within the range of 110°F to 160 °F of the present invention as in Claims 32 and 43 (as amended).

Therefore, Beebe, Jr. et al. do not make obvious the present invention as in Claims 13, 15-18, 23-28, 31-38, and 40-44 (as amended) either alone or with the other references of record. Consequently, the section 103 (a) rejections should be withdrawn.

Sturgill et al. (U.S. Patent Application No. 2003/0234063)

Sturgill et al. teach conversion coatings based on cobalt. The term "conversion coating", as used in the finishing industry, refers to the conversion of a metal's surface into a surface that will more easily accept applied coatings and/or provide for a more corrosion resistant surface. These coatings are typically rather thin, quickly and easily formed, and easily scratched. "Conversion coatings grow an oxide coating on the metal without an externally applied electrical potential. The protective film is produced by a chemical redox reaction between the metal surface and the conversion coating solution. The film is composed both of an oxide and integral corrosion inhibitor species formed during exposure to the conversion coating solution (paragraph [0008]." Sturgill et al. either use perborate to oxidize cobalt (paragraph [0053]) through chemical oxidation, which is done without an externally applied electrical potential or use electrolytic oxidization, which requires a high energy. The conversion coating of Sturgill et al. should have as "sufficient thickness to be effective as both a barrier film and a reservoir of Co.sup.+3 corrosion inhibitor" as in paragraph [0750]. Sturgill et al. teach a minimum thickness of about 25 nm (0.025 µm) and a maximum thickness of about 10,000 nm (10 µm) (paragraph [0750]). Paragraph [0750], for example clearly states that the conversion coating of Sturgill et al. is an oxide coating for corrosion protection

and not a wear resistant coating as is the cobalt-phosphorous-boron coating of the present invention.

Contrary to Sturgill et al., in the present invention cobalt is not oxidized to a trivalent charge state. The concentration of perborate in the plating solution as in Claims 28, as amended, is not high enough to cause chemical oxidization. The reason for this is that it is not the goal of the present invention or of Brenner et al. and Beebe, Jr. et al. to oxidize the cobalt metal. Since the main chemical reaction of the present invention is the reduction of the metal ion to the metal in the coating it would not have been obvious to use perborate, used by Sturgill et al. to oxidize the cobalt, in the plating solutions of Brenner et al. or Beebe, Jr. et al.

Also, Sturgill et al. teach an oxide coating for corrosion protection while the present invention teaches a wear resistant coating that meets the engineering requirements of aircraft wear coatings, such as chromium plate, that are defined in the Aerospace Material Specification AMS-QQ-C-320 for Chromium Plating (Electrodeposited). The minimum thickness of the coating of the present invention is 0.002 inches (51 μm) (as in Claims 13 and 28, as amended) while the maximum thickness of the conversion coating of Sturgill et al. is 10,000 nm (10 μm) (paragraph [0750]). Therefore, even the thickest coating of Sturgill et al. is thinner by a factor 5 as the thinnest coating of the present invention. Also, by being a wear resistant coating, the cobalt-phosphorous-boron coating of the present invention (as in Claims 13 and 28, as amended) cannot be easily scratched, as does the conversion coating of Sturgill et al. (paragraph [0051]).

Therefore, Sturgill et al. do not anticipate or make obvious the present invention as in Claims 13, 15-18, 23-28, 31-38, and 40-44 (as amended) either alone or with the other references of record. Consequently, the section 103 (a) rejections should be withdrawn.

Kedward et al. (U.S. Patent No. 4,305,792)

Kedward et al. teach a process and apparatus for coating an article with a layer of metal incorporating particles. In one example, a stainless steel panel is provided with a composite coating comprising a cobalt matrix including particles of chromium carbide. The plating solution includes cobalt sulfate, boric acid, and sodium chloride. The plating solution of Kedward et al. fails to contain boron as perborate, phosphite and phosphate. Cobalt chips contained in titanium baskets surrounded by anode bags are used as anodes (Col. 4, lines 22-33).

Contrary to Kedward et al., who use the cobalt chips as an anode and cobalt sulfate as a source of cobalt metal ions, the present invention as in Claims 17, 18 and 34 (as amended) utilizes cobalt chips or balls submerged into the plating solution as the source of cobalt metal ions. Also, Kedward et al. electrodeposit a cobalt matrix including chromium carbides, whereas the present invention (as in Claims 17, 18, and 34 (as amended)) electrodeposits a cobalt-phosphorous-boron coating. The plating solution of Kedward et al. fails to contain boron as perborate, phosphite and phosphate.

Cobalt chips could not have been used by Brenner et al. and Beebe, Jr. et al. since both use cobalt chloride in their respective cobalt-phosphorous plating solutions, which serves as a source of cobalt metal ions and chloride ions, whereas cobalt chips only provide cobalt metal ions. Using cobalt in the conversion coating process of Sturgill et al. would not have led to the plating solution of the present invention (as in Claims 17, 18, and 34 (as amended)), since Sturgill et al. obtain a corrosion-protection oxide coat while the present invention (as in independent Claims 13, 28, 36, and 41, as amended) obtains a wear resistant coating.

Therefore, Kedward et al. do not make obvious the present invention as in Claims 17, 18, and 34 (as amended) either alone or with the other references of record. Consequently, the section 103 (a) rejections should be withdrawn.

Du Rose (U.S. Patent No. 3,355,267)

Du Rose teaches nickel-electroplating baths to obtain a composite coating of three firmly bonded layers of nickel deposits bonded to a nickel substrate (Col. 1, lines 12-14). The nickel-phosphorous layer has a maximum thickness of 0.2 mils (0.0002 inches) (Col. 1, line 24) and is intended to be corrosion resistant (Col. 2, lines 3-6). Where cobalt is desired as an alloying constituent in the deposited nickel layers, the baths may be adjusted by adding cobalt salts, such as cobalt chloride, or cobalt sulfate (Col. 6, lines 53-58).

The present invention as in Claims 13, 28, 36, and 41 (as amended) and as in their dependent Claims 32 and 43 (as amended) teaches plating solutions that contrary to Du Rose do not contain nickel. The plating solution of the present invention may be used to obtain a cobalt-phosphorous-boron coating (as in Claims 13, 28, 36, and 41, as amended), while Du Rose obtains nickel and nickel-phosphorous coatings. Since nickel and nickel-phosphorous deposits have different material characteristics than cobalt-phosphorous deposits, one cannot easily apply the conditions of a nickel-phosphorous plating bath, such as temperature or pH value, to a cobalt-phosphorous plating bath. Consequently, it would not be possible to apply the teachings of Du Rose to the teachings of Brenner et al., Beebe, Jr. et al., and Sturgill et al. to accomplish the plating solution and the cobalt-phosphorous-boron coating of the present invention (as in Claims 13, 28, 36, and 41, as amended).

Furthermore, Du Rose teaches a triple-layer system to protect a

corrodable substrate while the present invention teaches a wear resistant coating that meets the engineering requirements of aircraft wear coatings, such as chromium plate, that are defined in the Aerospace Material Specification AMS-QQ-C-320 for Chromium Plating (Electrodeposited). The minimum thickness of the coating of the present invention is 0.002 inches (2 mils) (as in Claims 13, 28, 36 and 41, as amended) while the maximum thickness of the corrosion resistant coating of Du Rose is 0.2 mils (Col. 1, line24). Therefore, even the thickest coating of Du Rose is thinner by a factor 10 as the thinnest coating of the present invention.

Still further, the cobalt sulfate content listed by Du Rose in Table A is with 30 g/l outside of the range of 20 to 26 oz/gal (149 to 195 g/l) of the present invention as in Claims 28 and 41, as amended.

Still further, the phosphorous acid contend listed by Du Rose in Table C is with 6 g/l, 40 g/l, 2.5 g/l, 4.4 g/l, 6.6 g/l, and 10.2 g/l outside of the range of 1.6 to 2.6 oz/gal (12 to 19.5 g/l) of the present invention, as in Claims 13, 28, 36, and 41, as amended.

Therefore, Du Rose does not make obvious the present invention as in Claims 13, 28, 36, and 41 (as amended), either alone or with the other references of record. Consequently, the section 103 (a) rejections should be withdrawn.

Lichtenberger et al (U.S. Patent No. 4,786,390)

Claim 33, rejected as being unpatentable over Lichtenberger at al., has been canceled without prejudice or disclaimer of the subject matter. Consequently, the ground for the section 103 (a) rejections has been removed.

Appl. No. 10/772,683
Amdt. dated April 20, 2006
Reply to Office action of Mar. 8, 2006

Brar et al. (U.S. Patent No. 5,240,590)

Claims 38 and 41 rejected as being unpatentable over Brar et al. have been amended by deleting the element "cleaning said surface using dry abrasive blast". Consequently, the ground for the section 103 (a) rejections has been removed.

CONCLUSION

Applicant would like to thank the Examiner for the telephone interview of March 20, 2006.

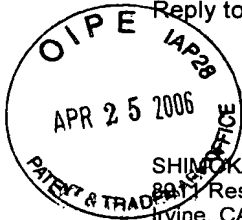
Reconsideration and withdrawal of the Office Action with respect to Claims 13, 15-18, 23-28, 31, 32, 34-38, and 40-44 is respectfully requested. It is believed that Claims 13, 15-18, 23-28, 31, 32, 34-38, and 40-44 are now in condition for allowance. Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

In the event the examiner wishes to discuss any aspect of this response, please contact the attorney at the telephone number identified below.

Respectfully submitted,

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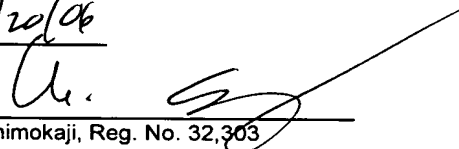


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